

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of

Use of Spectrum Bands Above 24 GHz For
Mobile Radio Services

GN Docket No. 14-177

Establishing a More Flexible Framework to
Facilitate Satellite Operations in the 27.5-28.35
GHz and 37.5-40 GHz Bands

IB Docket No. 15-256

Petition for Rulemaking of the Fixed Wireless
Communications Coalition to Create Service
Rules for the 42-43.5 GHz Band

RM-11664

Amendment of Parts 1, 22, 24, 27, 74, 80, 90,
95, and 101 To Establish Uniform License
Renewal, Discontinuance of Operation, and
Geographic Partitioning and Spectrum
Disaggregation Rules and Policies for Certain
Wireless Radio Services

WT Docket No. 10-112

Allocation and Designation of Spectrum for
Fixed-Satellite Services in the 37.5-38.5 GHz,
40.5-41.5 GHz and 48.2-50.2 GHz Frequency
Bands; Allocation of Spectrum to Upgrade
Fixed and Mobile Allocations in the 40.5-42.5
GHz Frequency Band; Allocation of Spectrum
in the 46.9-47.0 GHz Frequency Band for
Wireless Services; and Allocation of Spectrum
in the 37.0-38.0 GHz and 40.0-40.5 GHz for
Government Operations

IB Docket No. 97-95

REPLY COMMENTS OF QUALCOMM INCORPORATED

Dated: October 31, 2016

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INTRODUCTION AND SUMMARY

QUALCOMM is pleased to submit these reply comments in response to the Commission's *Further Notice of Proposed Rulemaking* proposing to open more than 17 GHz of spectrum in bands above 24 GHz for mobile and fixed broadband services.¹ *First*, the opening comments reflect widespread appreciation of the FCC's swift and groundbreaking work in the *Report & Order* to open up the 28 GHz, 37 GHz, 39 GHz, and 64-71 GHz bands for next generation wireless services. This work lays a solid foundation to support the *FNPRM's* proposals to open up additional millimeter wave spectrum for licensed mobile and fixed services.

Second, the opening comments contain near unanimous support for the proposals to open up additional millimeter wave spectrum, *i.e.*, the 24 GHz Bands (24.25-24.45 GHz and 24.75-25.25 GHz), 32 GHz Band (31.8-33.4 GHz), 42 GHz Band (42.0-42.5 GHz), 47 GHz Band (47.2-50.2 GHz), and 50 GHz Band (50.4-52.6 GHz), for licensed mobile and fixed services using spectrum blocks that are 200 MHz wide and larger.

Third, as many commenters explain, while the millimeter wave bands will play an important role in our 5G world, the spectrum bands below 6 GHz will be absolutely essential to enable highly reliable and robust wide area 5G network coverage. As Chairman Wheeler has aptly noted, the millimeter wave band proceeding "is the final piece in the spectrum trifecta of low-band, mid-band, and high-band airwaves that will open up unprecedented amounts of spectrum, [and] speed the rollout of next-generation wireless networks."² Therefore, it is crucial

¹ See Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, GN Docket No. 14-177, *Report and Order and Further Notice of Proposed Rulemaking*, FCC 16-89 (rel. July 14, 2016) ("*Report & Order*" and "*FNPRM*").

² See Prepared Remarks of FCC Chairman Tom Wheeler, "The Future of Wireless: A Vision for U.S. Leadership in a 5G World" at 3 (June 20, 2016) *available at* http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0620/DOC-339920A1.pdf (last accessed Oct. 31, 2016).

that the federal government continue its efforts to repurpose more mid- and low-band spectrum for 5G mobile broadband in parallel with this proceeding.

To realize the Commission's goals in this proceeding, Qualcomm and its wireless industry partners are actively developing millimeter wave mobile technologies that operate in these new bands. Qualcomm recently announced the world's first ever 5G modem — the Snapdragon X50 modem platform — that will operate in the 28 GHz band and provide 5 Gbps download speeds,³ demonstrating that millimeter wave spectrum can provide vast amounts of throughput in areas where demand continues to surge.

Qualcomm encourages the FCC to authorize licensed mobile operations in the second set of millimeter wave bands in the *FNPRM* in accordance with Qualcomm's opening comments and these reply comments, so consumers can receive the benefits of this high-band spectrum.

DISCUSSION

I. Virtually All Commenting Parties Support The FCC's Proposals To Implement Flexible Use Rules And Exclusively License The Additional Millimeter Wave Bands

There is near unanimous support for the Commission's proposals to exclusively license the additional millimeter wave bands and use a flexible regulatory framework to support the deployment of a full array of next-generation fixed and mobile service offerings.⁴ These

³ See Qualcomm Press Release, "Qualcomm Showcases 5G Leadership by Announcing its First 5G Modem Solution - Qualcomm Snapdragon X50 5G Modem Supports Early 5G Deployments and Field Trials, Helping OEMs to Develop Devices For Early 5G Networks," (Oct. 17, 2016) available at <https://www.qualcomm.com/news/releases/2016/10/17/qualcomm-showcases-5g-leadership-announcing-its-first-5g-modem-solution> (last accessed Oct. 31, 2016); see also Qualcomm Snapdragon X50 5G Modem website available at <https://www.qualcomm.com/products/snapdragon/modems/5g/x50> (last accessed Oct. 31, 2016).

⁴ See 5G Americas Comments at 2, 4; AT&T Comments at 2-4, 9; CTA Comments; CTIA Comments at 3, 8-10; Facebook Comments at 3-4; Fixed Wireless Communications Coalition ("FWCC") Comments at 2, 8; Huawei Comments at 1-5; National Spectrum Management

commenting parties recognize that a flexible regulatory approach enables the business judgments of individual FCC licensees to shape the nature of the services they provide. Indeed, the adoption of a common licensing and technical framework for the licensed spectrum bands above 24 GHz will give wireless service providers and equipment suppliers the ability to develop and deploy equipment and services at scale.⁵ This in turn will fuel a broader ecosystem, encourage rapid development and deployment of new types of services, enhance competition among wireless providers and suppliers to the U.S. and global markets, and benefit consumers. “[T]he development of 5G networks — and the technical advances expected to underlie such networks — is a national strategic priority to ensure that the U.S. remains at the forefront of technology development.”⁶

Accordingly, the FCC should open up the 24 GHz Bands (24.25-24.45 GHz and 24.75-25.25 GHz), the 32 GHz Band (31.8-33.4 GHz), the 42 GHz Band (42.0-42.5 GHz), the 47 GHz Band (47.2-50.2 GHz), and the 50 GHz Band (50.4-52.6 GHz) for licensed fixed and mobile services using spectrum blocks that are at least 200 MHz wide, as Qualcomm and others detailed in their opening comments,⁷ for these block sizes will allow systems to provide substantial peak data rates and overcome the dynamic variations in link quality that these high bands may experience. The wide variation in link quality resulting from mobile operations in the millimeter

Association (“NSMA”) Comments; Nokia Comments at 2; Samsung Comments at 1-5; Straight Path Comments at 3; T-Mobile USA Comments at 3-7, 13; TIA Comments at 2-4.

⁵ See e.g., Ericsson Comments at 4.

⁶ TIA Comments at 2 (citing FCC Chairman Commissioners’ statements approving *Report & Order* and *FNPRM*.)

⁷ See, e.g., TIA Comments at i (use of 200 & 400 MHz block sizes “will achieve the right balance between allowing large-bandwidth applications to develop, facilitating different types of business models and applications, ensuring there are multiple licensees in each market, and establishing a robust secondary market for spectrum with relatively low transactional costs for the parties involved.”); see also *id.* at 5.

wave bands, particularly in non-line-of-sight operation, are compensated for by using higher burst rates to maintain a high quality user experience.

The FCC also should license the spectrum for ten-year terms, provide a renewal expectancy so long as performance requirements are met, and use large geographic areas as it has done in the 39 GHz and lower spectrum bands.⁸

II. The FCC Should Rely Upon Proven Sharing Mechanisms And Encourage The Continued Study Of Novel Spectrum Sharing Approaches

Many commenting parties request that the FCC not import into the millimeter wave bands the three-tiered spectrum sharing approach that it has applied to the 3.5 GHz band. While Qualcomm and its wireless industry partners are working hard to develop the Spectrum Access System for the 3.5 GHz band, there are other more straightforward mechanisms to allow the millimeter wave bands to support next generation fixed and mobile operations.

For example, when considering the sensitive operations in the band directly below the proposed 32 GHz band (at 31.8-33.4 GHz), fixed and mobile services can be deployed in a manner that protects adjacent radio astronomy and earth exploration satellite services (“EESS”). Radio astronomy is typically in remote locations that can use protection zones to avoid interference from mobile service deployments, and affected EESS users can be protected using more simple means than a three-tiered sharing framework.⁹

Qualcomm explains in its opening comments that the Commission can look to spectrum sharing approaches that take advantage of the unique characteristics of millimeter wave RF propagation and novel interference conditions these bands experience to enable successful

⁸ See, e.g., T-Mobile USA Comments at 7; Verizon Comments at 3.

⁹ See, e.g., T-Mobile USA Comments at 14.

spectrum sharing with satellite operations. Average interference from a millimeter wave mobile handset and associated base station/small cell with a steerable antenna array is quite different from and varies instant to instant when compared to fixed operations in the millimeter wave bands or, for that matter, mobile operations in the sub-3 GHz range. Thus, simultaneous operations in close proximity can be enabled by spatially separating diverse operations.

In general, mobile devices operating in the millimeter wave bands can use lower transmit power and narrow beamwidths to reduce the interference impact and number of potential interference victims. Highly directional millimeter wave antenna systems on base stations/small cells mitigate interference to potential victim receivers because their narrow fixed beams continually move from device to device and any on-axis interference a victim experiences is a limited event. The interference is mitigated further as antenna beamwidth is reduced, which greatly lowers antenna gain towards the off-axis interference victims.

III. Commenters Unanimously Agree That Performance Requirements For These New High Bands Must Account For Novel Applications And Deployments

All parties who commented on the appropriate performance metrics for the millimeter wave bands request that they be as flexible as the underlying service rules to account for the broad range of 5G services, usage models, and applications that the wireless industry is developing.¹⁰ These parties recognize that millimeter wave deployments will differ from traditional cellular deployments in significant ways, so FCC performance requirements have to reflect those differences. Some deployments may, for example, comprise large numbers of

¹⁰ See Consumer Technology Association Comments at 5; CTIA Comments at 4, 16-17; Ericsson Comments; T-Mobile USA Comments at 26; TIA Comments at 17-19; *see also* FWCC Comments at 14 (supporting flexible metrics that address transient user populations via, *inter alia*, short-term high-volume options).

devices packed densely into small areas, while others may support service using a relatively small number of high-capacity devices deployed over a large area. Accordingly, the FCC should evaluate performance showings on a case-by-case basis at the early deployment stages to afford licensees the necessary flexibility to develop and deploy innovative new services and service models.¹¹

IV. Many Parties Agree That The Commission Should Not Implement A “Use It Or Share It” Regime In Any Exclusively Licensed Band

The FCC should not mandate sharing in any of the millimeter wave bands that are exclusively licensed for flexible use, including the 37.6-38.6 GHz band, because it will threaten U.S. leadership of millimeter wave system design and deployments.¹² The 37-37.6 GHz band the Commission has designated for shared, license-by-rule use via site licenses, can serve the same use cases as a “use it or share it” approach at 37.6-38.6 GHz. Also, as 5G Americas explains, “use or share” is a repackaged form of an unlicensed underlay, but there is no shortage of unlicensed spectrum in the millimeter wave bands to justify such a mandate.¹³

Given the nascent stage of mobile deployments in the millimeter wave bands, the FCC should not adopt “use it or share it” obligation at this time because it is currently unknown how

¹¹ In this regard, Qualcomm agrees with Verizon who supported the Commission’s approach in the *Report & Order* to import existing metrics from other bands while seeking input on appropriate future metrics as 5G technology and deployments rolls out. See Verizon Comments at 8.

¹² See 5G Americas Comments at 15-19; CCA Comments at 6-7; CTIA Comments at 19-20 (it could force licensees to deploy a rushed and inefficient network only to preserve license rights); Ericsson Comments at 19; Intel Comments at 16-20; Nextlink Wireless Comments at 23-25; Samsung Comments at 9; Straight Path Comments at 7-10; T-Mobile USA Comments at 24-26.

¹³ See 5G Americas Comments at 19-20; see also *id.* at 20-21.

licensees will use their new flexible use rights.¹⁴ Imposing such an obligation would introduce uncertainty at such an early, critical stage and deter investments necessary to make millimeter wave mobile deployments successful. In addition, as a result of the July 2016 *Report & Order* in this proceeding, there is now 14 GHz of unlicensed millimeter wave spectrum from 57-71 GHz that can be used by any terrestrial user on an unlicensed basis.

V. 3GPP Is Studying Whether Millimeter Wave Systems Benefit From The Flexibility Offered By Not Imposing Bandwidth Scaling Limits For Certain Device Classes

The FCC should not adopt the proposed bandwidth scaling limits, which apply to fixed and base stations, for transportable devices and mobile stations (*i.e.*, “UEs”)¹⁵ so the 3GPP standards body can continue to study whether 5G millimeter wave equipment designs can benefit from such flexibility. Imposing such bandwidth scaling limits at this time would unnecessarily override the standards process and constrain equipment design flexibility by lowering currently permissible transmit power levels for next generation devices that operate using less bandwidth.¹⁶ The Commission should let the standards process play out and not impose a bandwidth scaling limit for transportable devices or UEs at this time.

¹⁴ See *FNPRM* at ¶¶ 460-64.

¹⁵ See *FNPRM*, App. G, proposed rule section 30.202 - Power limits.

¹⁶ See Nextlink Wireless Comments at 30 (“Given that 5G technology is nascent, and that the technology is currently being developed to support a myriad of use cases—many of which do not yet exist—regulatory flexibility is a key to the success of 5G. Therefore, establishing power scaling factors based on bandwidth for transportable and mobile stations could inadvertently preclude some use cases that are not yet developed, as well as some that are already envisioned.”).

CONCLUSION

As Qualcomm and others explain in their opening comments, the millimeter wave bands will provide an important component of the 5G solution along with lower, sub-6 GHz spectrum bands. For this reason, the FCC should make bands proposed in the *FNPRM* available for mobile broadband as soon as possible in accordance with Qualcomm's opening comments and these reply comments.

Respectfully submitted,

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